Erosion Control Design for Stormwater Basins

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Design Criteria

- Maximum Drainage Area = 100 acres
- Minimum Surface Area (ft^2) = 435 x Q_{10} (or Q_{25})
- Minimum Volume = 1800 ft^3 per Disturbed Acre
- Dewatering Mechanisms: Skimmer + Riser Spillway
- Minimum Dewatering Time = 24 hours

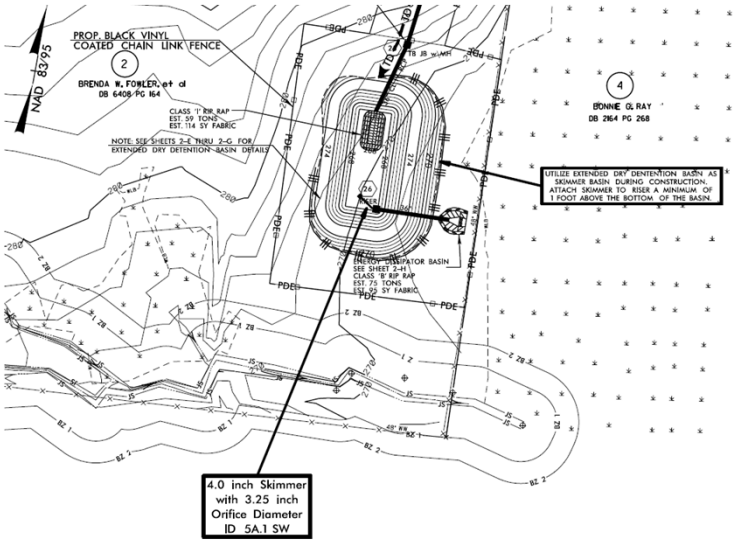
Design Procedure

1. Determine flow (Q) to Basin
2. Determine Disturbed Area Draining to Basin
3. Compute Required Surface Area
4. Compute Required Sediment Storage
5. Compare Requirements to Stormwater Basin Dimensions

Dewatering Analysis

- Size Skimmer Orifice based on Volume of Stormwater Basin
- Use Volume of Stormwater Basin 1 ft. above Basin Bottom
- Choose appropriate size Skimmer
- Check Primary Spillway (Riser) to Convey 2-yr Storm
  -NCDOT Primary and Emergency Spillways Convey 50-yr Storm

Stormwater Basin & EC Plans



Case Study: Timber Drive Project

- Located in Garner, NC
- Length of 1.5 miles
- Construction began in July 2010
- Surrounding Land Use:

  -Shopping Centers

  -Private Home Sites

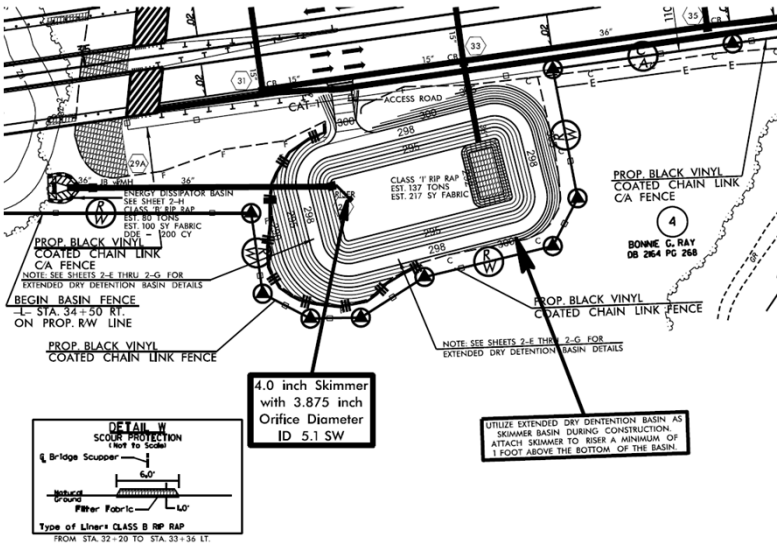
  -Forests

Stormwater Basin Design Info (EC)

- Disturbed Area = 13.3 Acres
- Undisturbed Area = 0.02 Acres
- Q_{25*} = 23.23 cfs

  *-Neuse River Basin

Initial EC Design



Stormwater Basin Design Spreadsheet

	A	B	C	D
1	25-Year Stormwater Basin Design	TIP No. :	X-XXXX	
2				
3	Construction Sheet #			
4	Closest City	Raleigh		
5	**Design 1**			
6	Basin ID(Sta. No./Const. Line/lt,rt or median)			
7	**Calculate Peak Flow: Q = CIA**			
8	Time of Concentration,Tc (min) =	30	5	5
9	Disturbed Area (Acres)	13.3	0	0
10	Undisturbed Area 1 (Acres)	0.02	0	0
11	Undisturbed Area 2 (Acres)	0	0	0
12	Undisturbed Area 3 (Acres)	0	0	0
13	Total Drainage Area (Acres)	13.32	0.00	0.00
14	Disturbed Area C Factor	0.45	0.00	0.00
15	Undisturbed Area 1 C Factor	0.05	0.00	0.00
16	Undisturbed Area 2 C Factor	0.00	0.00	0.00
17	Undisturbed Area 3 C Factor	0.00	0.00	0.00
18	Total Drainage Area C	0.45	N/A	N/A
19	Rainfall Intensity Factor (in/hr)	3.88	7.78	7.78
20	Peak Flow Rate Q_{25} (ft^3/s)	23.23	N/A	N/A
21	**Required Surface Area and Sediment Storage**			
22	Surface Area (ft^2) = 435 x Q_{25}	**10103**	N/A	N/A
23	Sediment Storage (ft^3) = 1800 ft^3 per Disturbed Acre	23940	N/A	N/A
24	**Suggested Basin Size**			
25	Length (ft)	142	N/A	N/A
26	Width (ft)	71	N/A	N/A
27	**Stormwater Basin Dimensions**			
28	Basin Length (ft)	174		
29	Basin Width (ft)	87		
30	Basin Depth (ft)	6		
31	Basin Sideslope Grade (i.e. 2 for 2:1)	3		
32	**Stormwater Basin Analysis**			
33	Basin Surface Area (ft^2)	15138	N/A	N/A
34	Basin Volume (ft^3)	65232	N/A	N/A
35	Additional Storage Requirement (ft^3)	0	N/A	N/A
36	**Skimmer Sizing**			
37	Orifice Diameter (in.)	3.875	N/A	N/A
38	Skimmer Size (in.)	4	N/A	N/A

Initial Basin Construction

Granite Rock…

And Sand!

Construction Concerns

- Rock Layer Close to Surface
- Sandy Loam Material Used for Berms -Onsite
- Inadequate Compaction of Soil in Berm

Erosion at Barrel Pipe

Repair Plan

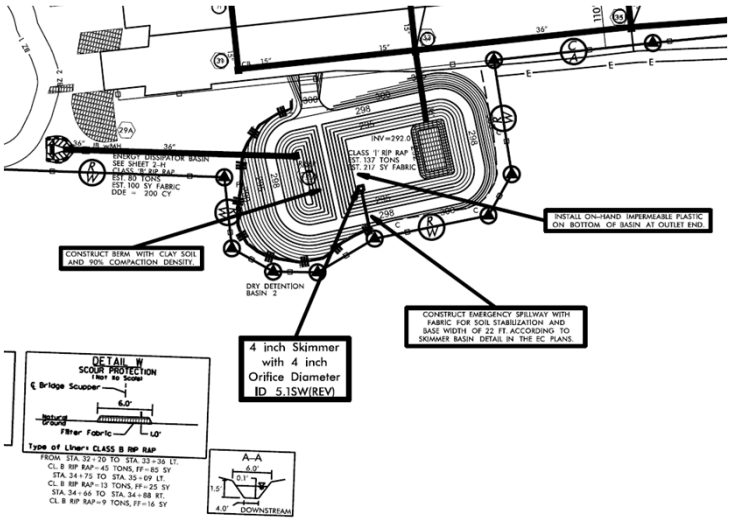
- Interim EC Design with Temporary Berm
- Rebuild Embankment with Clay Material
- Achieve 90% Compaction of AASHTO T 99 Test
- Install Anti-Seep Collar on Barrel Pipe

Intermediate Design Information

- Disturbed Area = 9 Acres
- Undisturbed Area = 1 Acre
- Q_{25*} = 21.75 cfs

  *-Neuse River Basin

Interim EC Design



Now a Permanent Stormwater Basin!

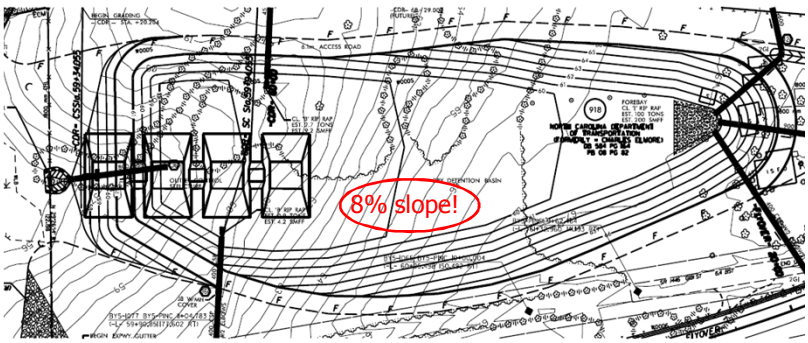
Design Constraints

- Rock Layer Close to Surface
- Soils
- High Water Table
- Topography
- Width of Stormwater Basin

Dry Detention Basin on Slope

Width of Stormwater Basin – 240 ft.

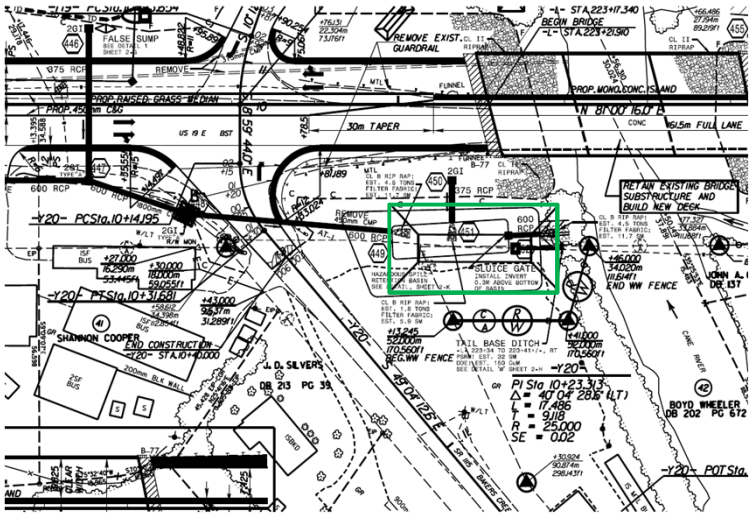
Width of Skimmer Basin – 80 ft.



Dry Detention Basin Constructed

Dry Detention Basin Constructed

Small Hazardous Spill Basin



NCDOT Stormwater Basins

- Dry Detention Basin
- Wet Detention Basin
- Hazardous Spill Basin

http://ncdot.org/doh/PRECONSTRUCT/highway/hydro/pdf/StormwaterBMPMarch08_A1.pdf

Basin with Skimmer and Stone Spillway

Hazardous Spill Basin with Skimmer

Hazardous Spill Basin w/ Pool

Hazardous Spill Basin Dewatering

Detention Basin w/ Skimmer

Skimmer with CSP

Construction Specs

- Minimum of 3 Baffles with Equal Spacing
- Anti-Seep Collars

  ftp://ftp-fc.sc.egov.usda.gov//IL/engineer/supplements/6-36.1.pdf

- Berm Material

  -Compact Embankment to at least 90% of AASHTO T 99 Test

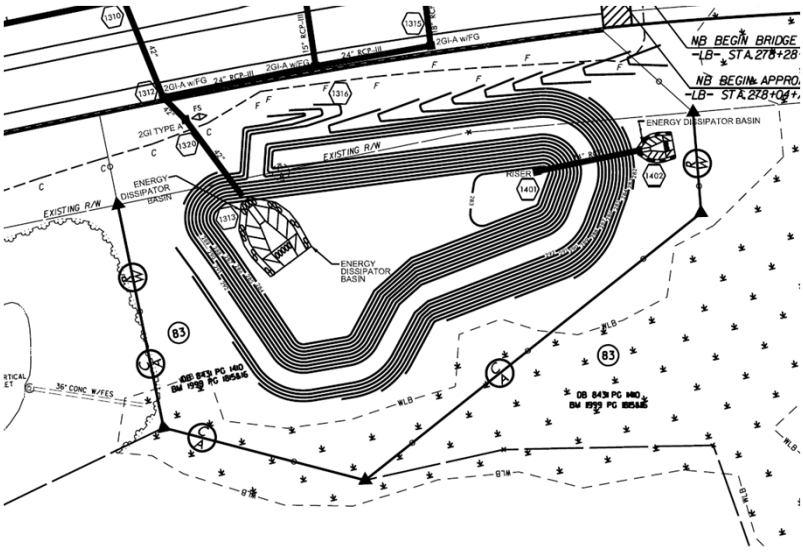
Slope Stabilization

- Permanent Seed Mix
- Matting (Excelsior at minimum)
- Permanent Matting (TRM)
- Geotextile (NCDOT Type 4, 50 mil., etc.)
  -Interim
  -Impermeable

Enhancements to Stormwater Basins

- Forebays / Energy Dissipators
- Incorporation of Flocculants
- Infiltration

Energy Dissipator in Basin



Flocculant in Basin

Permanent Basin w/ Infiltration

Design Tips

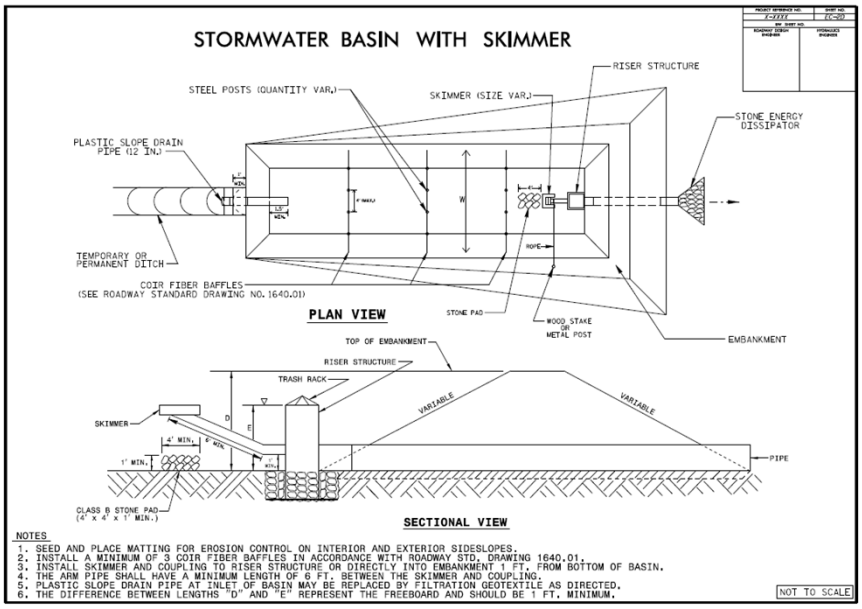
- Convey Runoff to Basin in Non-erosive Manner
- Remember Volumes for Skimmer Orifice
  - -Volume of Stormwater Basin
  - -Volume of Basin 1 ft. above bottom
- Include ALL Construction Specifications

Before Basin becomes Permanent…

- ALL Drainage Areas to Basin Stabilized
- Drainage System Completely Installed
- Interior Slopes Stabilized
- Sediment in Basin Removed

Detention Basin Needs Maintenance

Skimmer in Sediment



Web Site

- Stormwater Basin Design Spreadsheet

http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/soil_water/erosion_control/downloads.html

- Detail

http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/soil_water/Details/

- Special Provision

http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/soil_water/special_provisions/

Questions?